Design

Summary of the requirements

The idea is to create an hyperledger network between multiple service provider that offer different type of services (e.g video streaming, hosting, vpn access …)

This network will allow users to rent to other users their access to services and gain in return HyperCash (HC).
Then they will be able to rent access to other services belonging to the network using the gained currency. So this technology will basically allow the creation of a marketplace of access to services between users.
Users will not be able to convert HyperCash into real money.

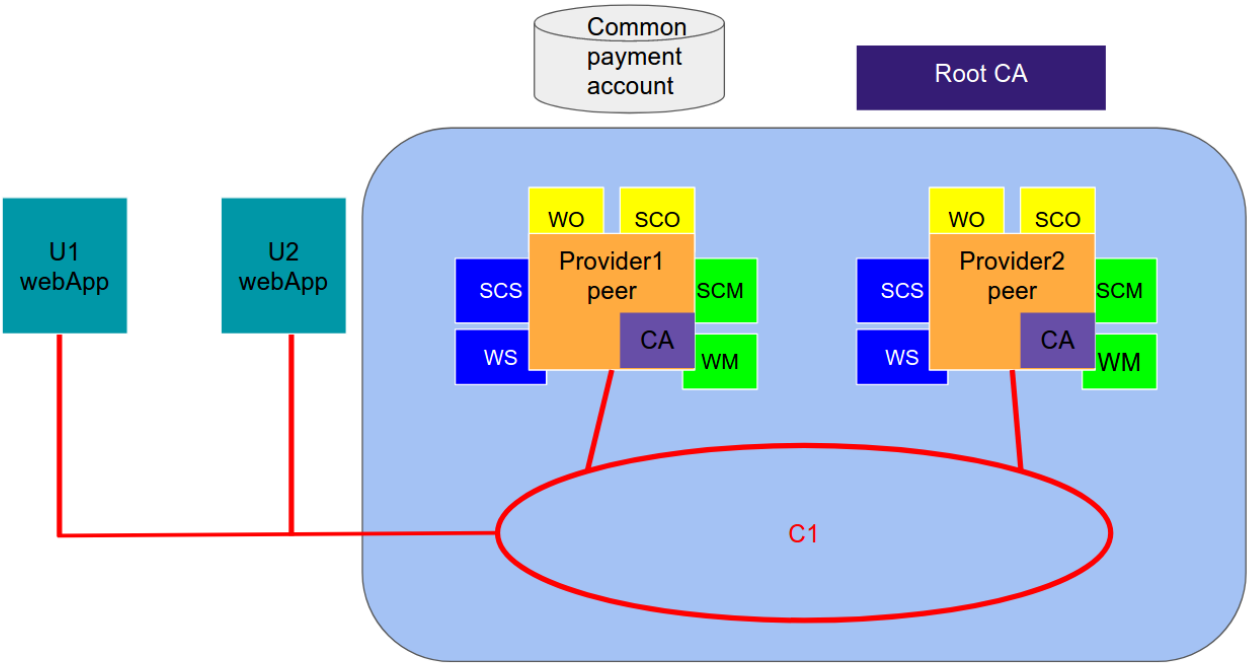
Network design

Parties involved

- Service providers, which contains
  - server with related database that allows access of the service to the client.
  - hyperledger peer.
  - hyperledger ordering node.
  - CA that provides certificates to the end user.
  - End users
  - they will use the WebApp to interact to the hyperledger blockchain.
  - CA (trusted root CA between all the organizations)
  - Common payment account, external to the Hyperledger blockchain.

The network is composed by one application channel on which are deployed three chaincodes (one related to subscriptions, one related to money and one which controls the rent offers). Each service provider will have a peer which executes the three smart contracts (SCS, SCM and SCO respectively) and keeps an updated version of the three world states (WS, WM and WO). The endorsement policies and the access control are different based on the type of the transaction. Each provider will have also 1 ordering node, and they will reach consensus through Raft.
The user will connect to the network through a web app which is stored in the customer device. There he can check the state of its own wallet, issue a new offer, read the offer world state or rent a subscription.
During the registration of a user, a service provider will sign the new certificate send it back to the user and issue it on the system channel.

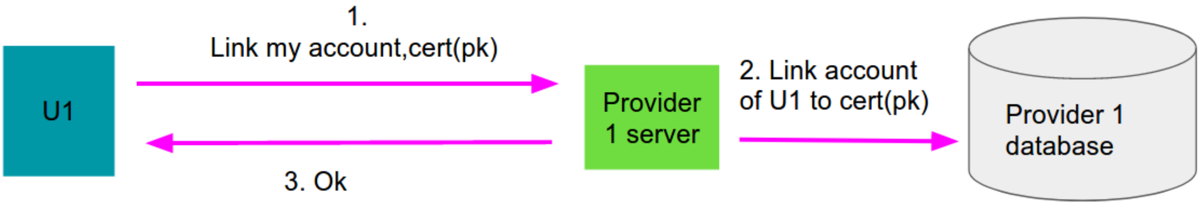
Example network with 2 SP and 2 users:



Application Design

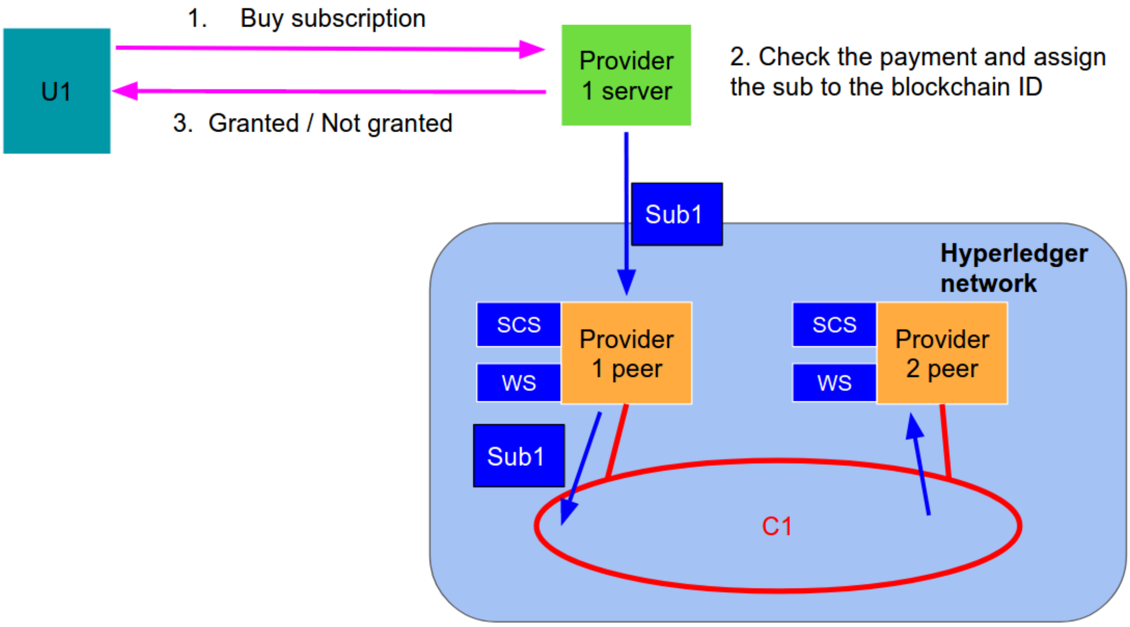
Service provider side

- Link account page
  This page will allow users to link their "normal account" to the blockchain one. The user will have to send a signature to prove that he own the sk related to his pk. The SP will have to modify his internal database in order to link the "normal" account to the user identifier.

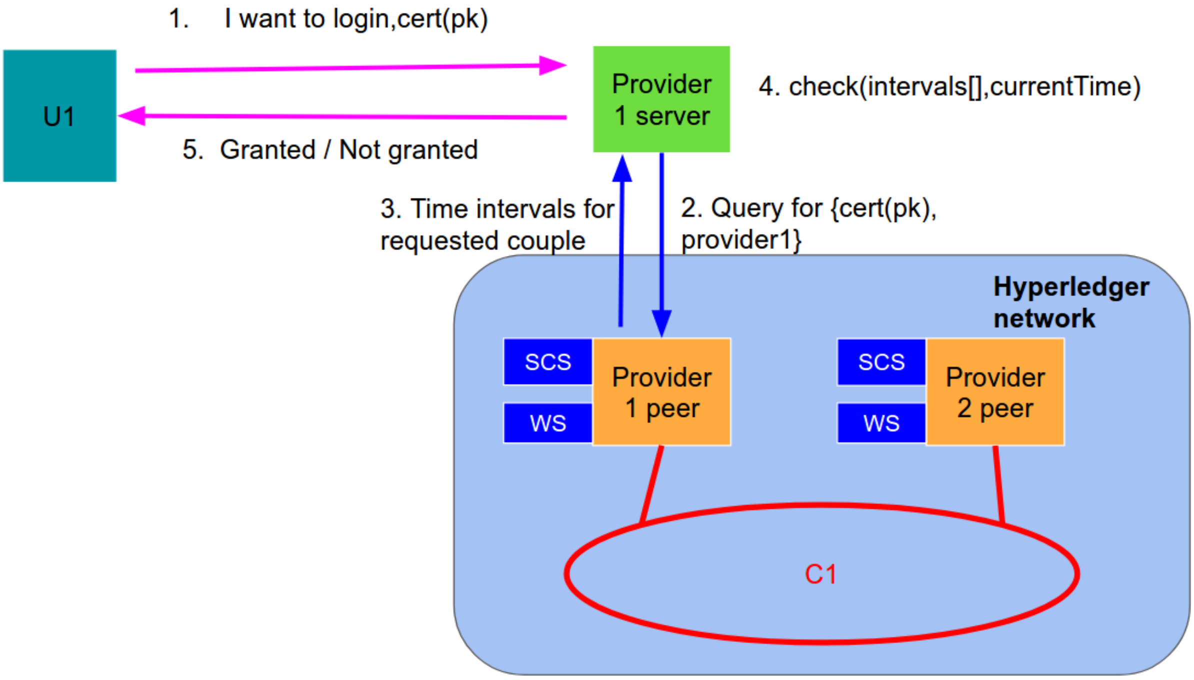


- Issue subscription

When a user subscribes to a new service, if it chooses to share the subscription (Sub1) within the network, the Service Provider will issue the new subscription to the channel.
All the other peer in the network will add it to their ledger, if the data is valid.



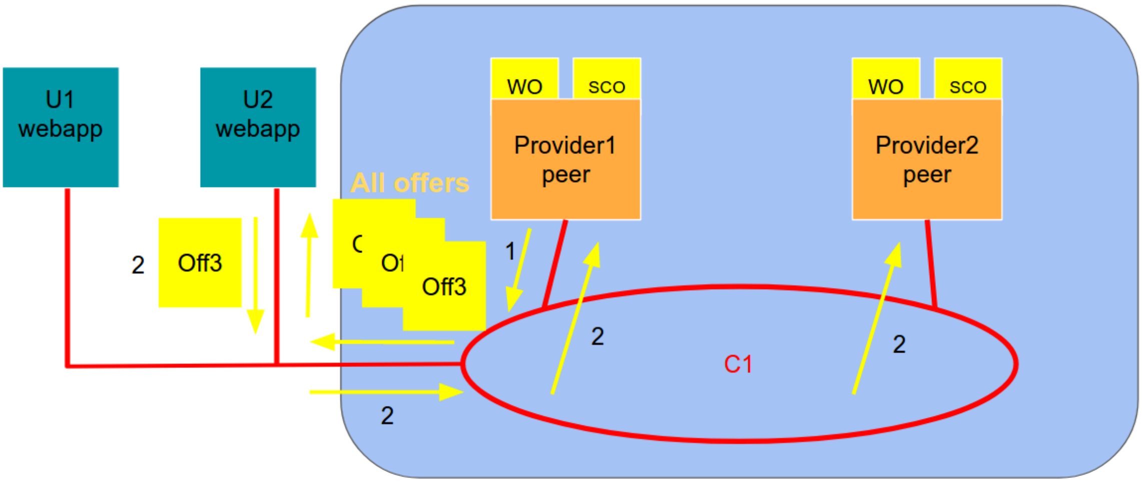
- Login with Hyperledger to access the Service
  This will be an additional button (Like "login with google") that the user will be able to use in order to use his certificate to identify himself and login to the service. The provider will check on the blockchain if the user really has access to the service at this moment in time.


1. I want to login,cert(pk)
U1
Provider 1 server
4. check(intervals[],currentTime)
5. Granted / Not granted
3. Time intervals for requested couple
2. Query for {cert(pk), provider1}
Hyperledger network
SCS
WS
Provider 1 peer
SCS
WS
Provider 2 peer
C1

Client side (webapp)

The client side webapp will handle the wallet of the user and provide a graphical interface in order to connect to the blockchain and perform the operation specified below.
The application will also handle the payments to the blockchain.
Operations:

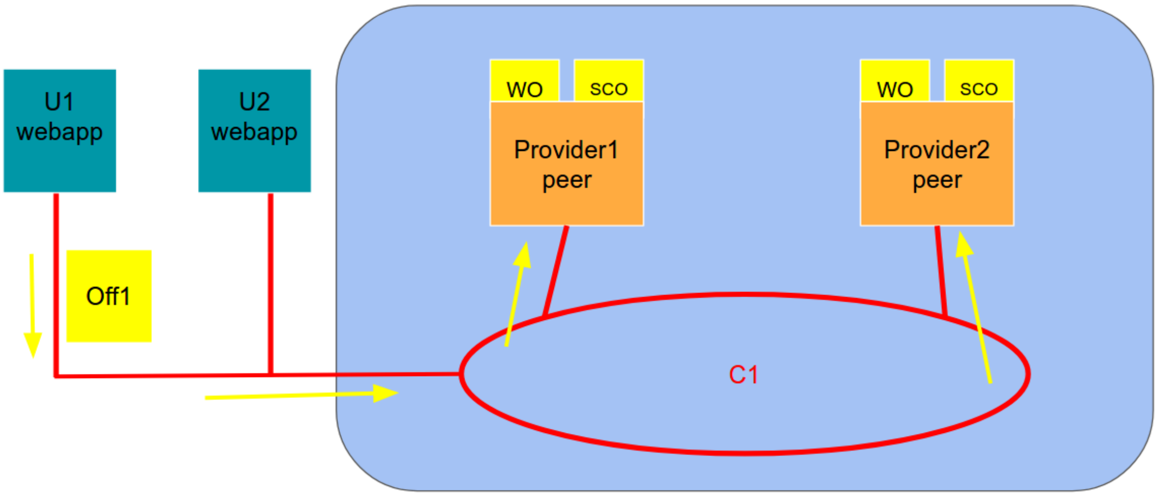
- retrieve all offers & eventually accept an offer



The process of accepting an offer from the ledger consists in 2 phases:

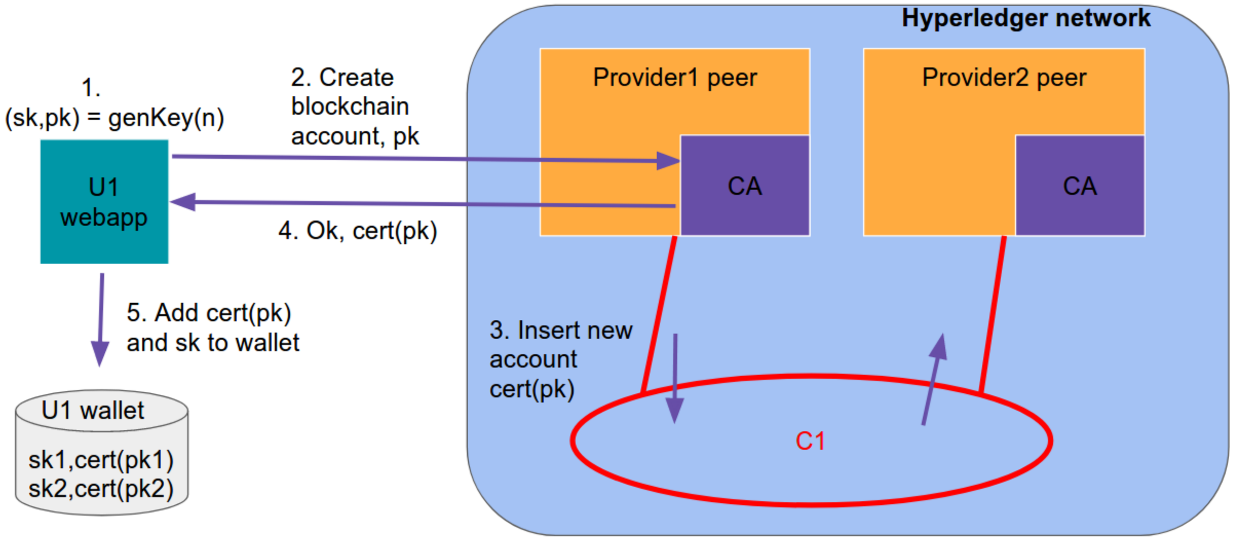
1. the user queries the offers smart contract and gets all the offers (Off1,Off2,Off3).
2. the user decides which one he wants (Off3) and he sends it on the channel so that the provider can update the state.

- insert a new offer



When a user wants to add an offer (Off1) to the ledger it requests a write to the ledger, if the offer is legitimate the service providers approves it and adds it to LO (Ledger of Offers).

- register to the network



When a new user register via the webapp it creates the key pair (sk,pk), connect to the CA of the network, and get a certificate that identifies them into the blockchain network.

Chaincode design

subscription world state

It is used to keep track of the owner of a certain subscription for a determined period of time. The update of the world state happens when a User subscribes to a new service outside the network or when a user rents an existing subscription for a fixed time. In the second case the SP will update the ledger removing the time slot from the previous user and adding it to the new one.
The access control and transaction validation for this Smart Contract should be majority + the service provider that is related to the subscription.
The methods that needs to be implemented are: new subscription, split subscription, query.

UserId	Provider	SubscriptionId	Duration
A	Provider 1	001	[0: [01/01/2020 00.00,31/12/2020 12.59], 1: […,…]]

money world state

It will represent the state of the wallet of each user inside the blockchain.
The endorsement policy will require that at least the majority of the SP share the same result and sign it.
The function that need to be implemented are: addiction, subtraction,query and verifyPayment

UserId	amountOfMoney	LastPaymentDate
A	100	03/09/2020

offers world state

It is the collection of all the offers. The user can trigger a request to add a new offer inside the ledger. When a second user decides to accept this offer the SCO (Offers Smart Contract) has to trigger a change the other 2 chaincodes in order to keep updated the wallets of the two users and the owner of the subscription.
The endorsement policy requires that the majority of the SPs agree on the transaction. This prevent that a single service provider stops a user from making rent requests, as this would allow the SP to benefit from the network, without actually providing the service. Moreover it also allows consistency because when the transaction is approved it will also modify the subscription world

state and prevent a user from renting the same slot time twice. On the other hand other service providers will not have any interest to validate fake request from the moment that it will result in a bigger contribution to the blockchain from the victim service provider. This is why we think a majority vote is enough for this type of transaction.
methods: publish,accept,query

UserId	Provider	SubscriptionId	startTime	endTime	price
A	Provider 1	001	07/07/2020 13.00	07/07/2020 14.00	50 HC

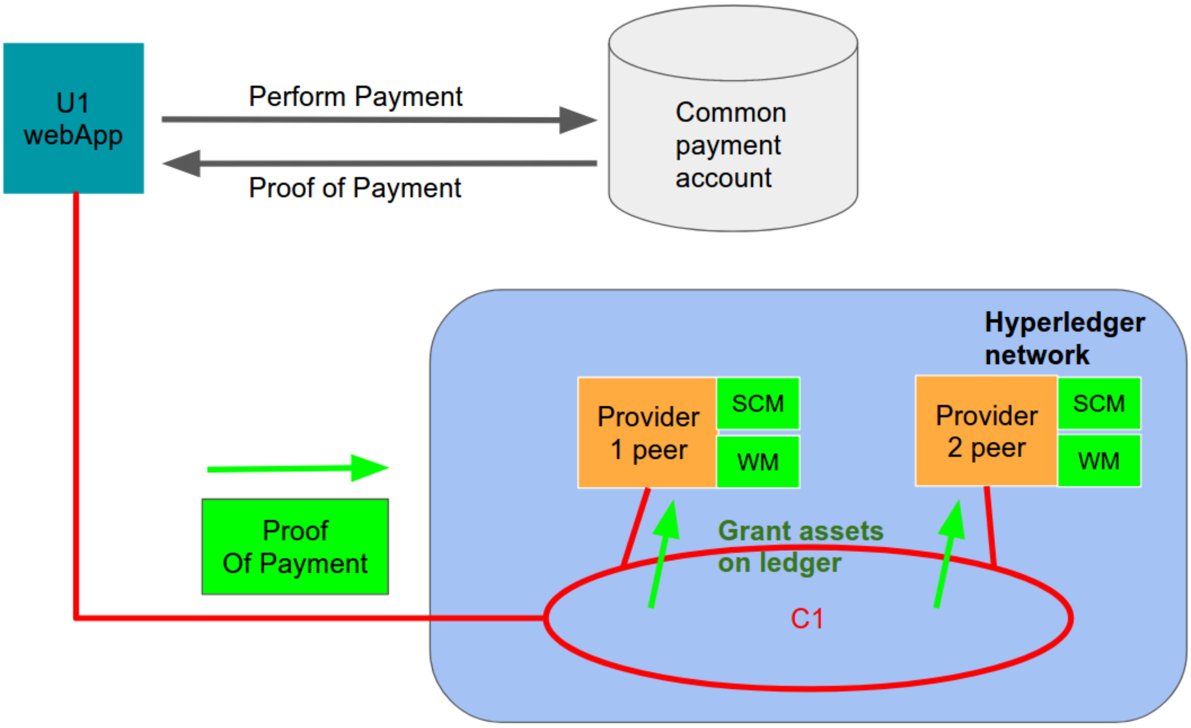
Economic returns

The use of the network will require the payment of a monthly fee for all the users. Moreover, each user can buy extra coins to rent subscriptions using real money. Therefore, to prevent an excess of coin in the network, which would prevent the user from buying new ones, at each transaction is applied a tax.

All the money collected by the previous means will be distributed to all the organization that partecipate to the network. The split could be equal for each company or could be based on the contribution of the service provider in the network (how many subscription are rented).

Common payment design

There will be a common payment account (bank account or ethereum account) where users will deposit their money when paying to the network.
In order to claim the assets the client will invoke a transaction where he will provide a proof of payment. The peers will verify that the payment has been actually performed and will grant the assets on the blockchain.



Improvements

- enable cross device auth (crypted key on sp solution)
- make only necessary data public
- bidding system

- signing of offer from user